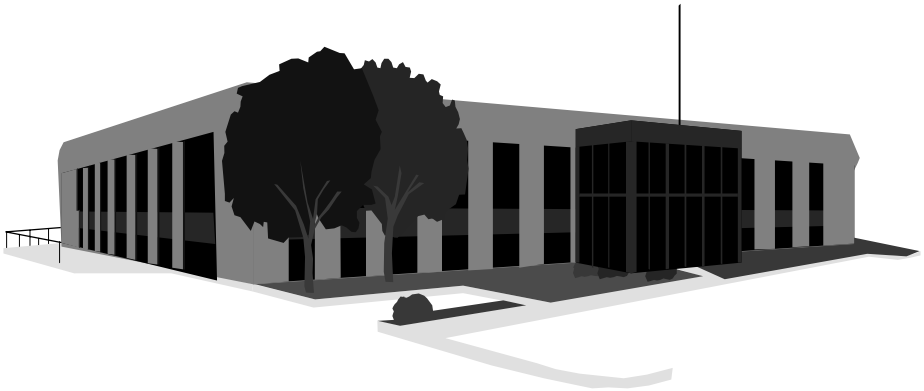
INDOOR AIR QUALITY ASSESSMENT

Revere High School
101 School Street
Revere, Massachusetts



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
June, 2001

Background/Introduction

At the request of a parent, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality concerns at Revere High School. Specific concerns were expressed about water damage/microbial growth within the ceiling material on the third floor of the building.

On March 12, 2001, a visit was made to this school by Cory Holmes, Environmental Analyst of the ER/IAQ Program and Suzan Donahue, BEHA Research Assistant, to conduct an indoor air quality assessment. BEHA staff was accompanied by Tom Hill, Plant/Maintenance, for portions of the assessment.

The school is a three-story concrete/cement block building constructed in 1974 that houses grades 9-12. Located at ground level are general classrooms, library, school nurse, cafeteria, kitchen, auditorium, shops, gymnasium and office space. The second floor mostly consists of general classrooms. The third floor contains science classrooms and art rooms. Windows in the building are openable.

Methods

Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551.

Results

This school has a student population of approximately 1375 and a staff of approximately 150. The tests were taken during normal operations at the school. Test results appear in Tables 1-11.

Discussion

It can be seen from the tables that carbon dioxide levels were elevated above 800 parts per million of air (ppm) in sixty-two of ninety two areas surveyed, indicating a ventilation problem in these areas of the school. It is also important to note that a number of classrooms had open windows during the assessment, which can greatly contribute to reduced carbon dioxide levels.

Fresh air in most classrooms is supplied by a unit ventilator (univent) system (see Picture 1). Univents draw air from outdoors through a fresh air intake located on the exterior walls of the building (see Picture 2) and return air through an air intake located at the base of each unit. The mixture of fresh and return air is drawn through a filter and heating coil, and is then expelled from the univent by motorized fans through fresh air diffusers (see Figure 1). Univents were found turned off in classrooms throughout the school. Obstructions to airflow, such as papers and books stored on univents and bookcases, carts and desks in front of univent returns were seen in a number of classrooms. A number of univents contained accumulated dirt/debris. These univents should be cleaned before operating to prevent aerosolization of this material. In order for univents to provide fresh air as designed, intakes must remain free of obstructions. It is important that these units be activated and allowed to operate during school hours.

Ventilation for core rooms and common areas is provided by ducted air handling units (AHUs) located on the roof or within mechanical rooms (see Picture 3). Fresh air is distributed via ductwork connected to ceiling-mounted air diffusers. The amount of fresh air drawn into the units is controlled by moveable louvers connected to an actuator motor that adjusts to alter fresh air intake. Return vents draw air back to the units through wall or ceiling-mounted grilles.

Exhaust ventilation in classrooms with univents is provided by a mechanical system. The exhaust system in each classroom consists of ceiling-mounted vents that draw air out of the building powered by rooftop motors (see Picture 4).

In order to have proper ventilation with a univent and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. According to school department officials, the date of the last balancing of these systems was conducted in 1996. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997, BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings ranged from 68^{o} F to 77^{o} F. The BEHA recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. It is difficult to control temperature and maintain comfort without operating the HVAC equipment as designed (e.g., deactivating univents). In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

Relative humidity in the building was below the BEHA recommended comfort range in all areas sampled. Relative humidity measurements ranged from 16 to 25

percent. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

A number of classrooms have water-damaged ceiling tiles which can indicate leaks from either the roof or plumbing system (see Picture 5). Active water leaks were observed in the cafeteria, where trash barrels were placed beneath to catch dripping water (see Picture 6). Water-damaged ceiling tiles can provide a source of microbial growth and should be replaced after a water leak is discovered.

Ceilings on the third floor are comprised of a spray-on cellulose material (see Picture 7). The texture of these ceilings creates a surface, which is very difficult to adequately clean. With age, these ceilings have become discolored from accumulated dirt, dust and other particulates. In some areas, the ceiling has also become water damaged and stained from roof leaks. A number of areas of historic roof leaks have been repaired by the Revere School Department. In addition, a request for proposals has been issued for roof replacement (see Attachment). The Revere School Department has also contracted ATC Associates Inc. (ATC) to conduct bi-annual indoor air quality surveys. ATC recommended that water damaged ceiling materials be removed prior to the installation of a new drop ceiling in the SPED area (ATC, 1999). During the assessment, no active roof leaks on the third floor were reported to or observed by BEHA staff.

Window caulking was crumbling/damaged throughout the building (see Picture 8). Water vapor was observed collecting inside the double-paned window glass in a number of areas (see Picture 9). This indicates that the window's water seal is no longer intact. Broken windows were also observed in several rooms (see Picture 10). Water penetration through windows/frames can lead to mold growth under certain conditions. Replacement of caulking and repairs of window leaks are necessary to prevent further water penetration.

Several classrooms contained a number of plants. Plant soil and drip pans can serve as a source of mold growth. Plants should also be located away from univents and exhaust ventilation to prevent aerosolization of dirt, pollen or mold. Room C9 contained an aquarium with standing water. When not in use, aquariums should be properly cleaned to prevent bacterial growth, mold growth and nuisance odors. Classroom C13 contained an aquarium green with algae and a birdcage with accumulated bird wastes. Birds can be a source of disease, and bird wastes and feathers can contain mold and mildew, which can be irritating to the respiratory system.

Other Concerns

Several other conditions in the building can result in air quality complaints. The chemical storage areas contained a number of hazardous chemicals stored in a manner that could impact indoor air quality. The following conditions are examples of improperly stored chemicals.

- Potentially reactive materials (nitric acid and ammonia) are stored on the same shelf.

- Flasks containing chemicals were sealed with stoppers made of cork or plastic wrap held in place with rubber bands. Use of these materials can lead to the slow evaporation of materials from these containers.
- Reuse of original bottles for storage of other chemicals.
- Flasks filled with chemicals are labeled by chemical formula and not name (see Picture 11).

Classroom 114 contains a chemical hood. Several materials were stored within the chemical hood, including ammonia and hydrochloric acid (see Picture 12). The exhaust fans were deactivated. The chemical hood exhaust ventilation should be operational at all times that materials are within this equipment to remove off-gassing vapors and odors. Stock bottles of chemicals should be returned to chemical storage areas once experiments have been completed.

Room 311 contains two pottery kilns. One kiln was connected to flexible ductwork to an exhaust fan in the window. The other, reportedly not used, was disconnected from the flexible ductwork. The ductwork was connected to the same exhaust fan as the first kiln, but was open to the floor (see Picture 13). Pottery kilns can produce carbon monoxide and sulfur dioxide, which can cause respiratory symptoms in exposed individuals. The open end of the ductwork should be sealed/removed to improve exhaust capabilities for the kiln in use.

Pottery items were found drying on top of the univent in art room 312. Accumulated dirt/dust/pottery debris was also noted within the interior of the univent. Clay dust is a fine particulate that can be easily aerosolized and distributed by the air stream of the univent diffuser.

Wall cracks, utility holes and missing/dislodged ceiling tiles were noted in a number of classrooms throughout the building. These areas are breaches of the building envelope, which can serve as egress for vapors, fumes, dusts, and other odors between rooms and floors.

The main office and teachers' lounges have photocopiers. Volatile organic compounds (VOCs) and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, D., 1992). School personnel should ensure that local exhaust ventilation is activated while equipment is in use to help reduce excess heat and odors in these areas.

Accumulated chalk dust was noted in several classrooms (see Picture 14). Chalk dust is a fine particulate, which can be easily aerosolized and is an eye and respiratory irritant. Several classrooms contained dry erase boards and dry erase markers. Materials such as dry erase markers and dry erase board cleaners may contain volatile organic compounds (VOCs), (e.g., methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve) (Sanford, 1999), which can be irritating to the eyes, nose and throat.

Cigarette butts were observed in toilets and exhaust vents in several restrooms (see Picture 15). Environmental tobacco smoke can have a marked effect on indoor air quality. Environmental tobacco smoke is an indoor air pollutant, a respiratory irritant and can exacerbate the frequency and severity of symptoms in asthmatics. The most effective method of preventing exposure to environmental tobacco smoke is to have smoke free buildings. M.G.L. Chapter 270, Sec. 22 prohibits smoking in public buildings, except in an area which has been specifically designed as a smoking area (M.G.L., 1987).

Exposed fiberglass insulation was noted in the corner/wall junctions of classrooms 231 & 232 (see Picture 16). If exposed, fiberglass insulation material can release fibers and be a source of skin, eye and respiratory irritation.

Conclusions/Recommendations

A number of conditions were observed at RHS that can potentially affect indoor air quality. To improve air quality at RHS a number of remedial steps can be implemented. Some of these conditions can be remedied by actions of building occupants. Other remediation efforts will require alteration to the building structure and/or ++equipment. For these reasons a two-phase approach is required, consisting of more immediate **(short-term)** measures to improve air quality and **long-term** measures that will require planning and resources to adequately address the overall indoor air quality concerns. In view of the findings at the time of the visit, the following recommendations are made:

In view of the findings at the time of this assessment, the following **short-term** recommendations are made:

1. To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy independent of classroom thermostat control.
2. Examine each univent for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each room.

3. Inspect exhaust motors and belts periodically for proper function, repair and replace as necessary.
4. Remove all blockages from univents and exhaust vents.
5. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
6. Replace any remaining water-stained ceiling tiles and building materials. Examine the area above and around these areas for microbial growth. Disinfect areas of water leaks with an appropriate antimicrobial.
7. Move plants away from univents in classrooms. Examine drip pans for mold growth and disinfect areas of water leaks with an appropriate antimicrobial where necessary.
8. Replace missing ceiling tiles, to prevent the egress of dirt, dust and particulate matter into classrooms.
9. Have a chemical inventory done in all storage areas and classrooms. Properly store flammable materials in a manner consistent with the local fire code. Discard hazardous materials or empty containers of hazardous materials in a manner consistent with environmental statutes and regulations. Label chemical containers with the chemical name of its contents. Follow proper procedures for storing and securing hazardous materials.

10. Remove/seal unused local kiln exhaust (shown in Picture 13) to improve local exhaust capabilities of active vent.

11. Do not use chemical hoods for storage. Operate chemical hood exhaust fans at all times that chemicals are present within this machinery.

12. Obtain Material Safety Data Sheets (MSDS) for chemicals from manufacturers or suppliers. Maintain these MSDS' and train individuals in the proper use, storage and protective measures for each material in a manner consistent with the Massachusetts Right-To-Know Law, M.G.L. c. 111F (MGL, 1983).

13. Prohibit smoking in this building in accordance with Massachusetts law (M.G.L. Chapter 270, Sec. 22).

14. Clean chalkboards, dry erase boards and trays regularly to avoid the build-up of excessive chalk dust/marker particulate.

15. Cover exposed fiberglass insulation in classrooms 231 & 232.

The following **long-term measures** should be considered:

1. Continue with plans to replace third floor roof in accordance with attached RFP.

2. Repair/replace missing or damaged window caulking and broken windows building-wide to prevent water penetration.

References

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OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

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Schmidt Etkin, D. 1992. Office Furnishings/Equipment & IAQ Health Impacts, Prevention & Mitigation. Cutter Information Corporation, Indoor Air Quality Update, Arlington, MA.

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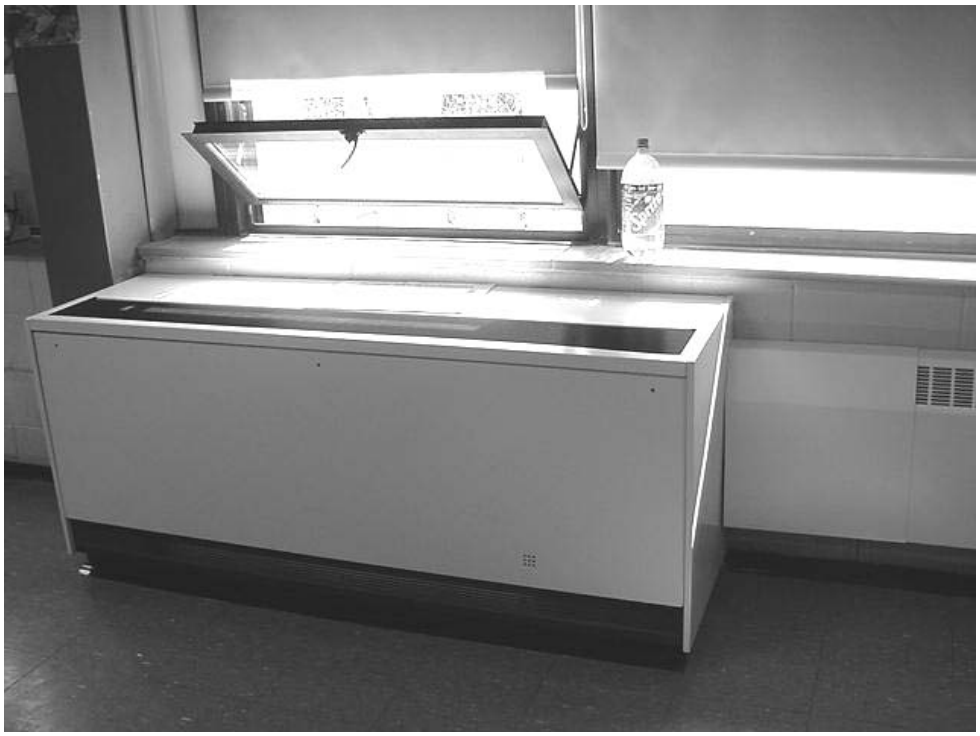
Picture 1

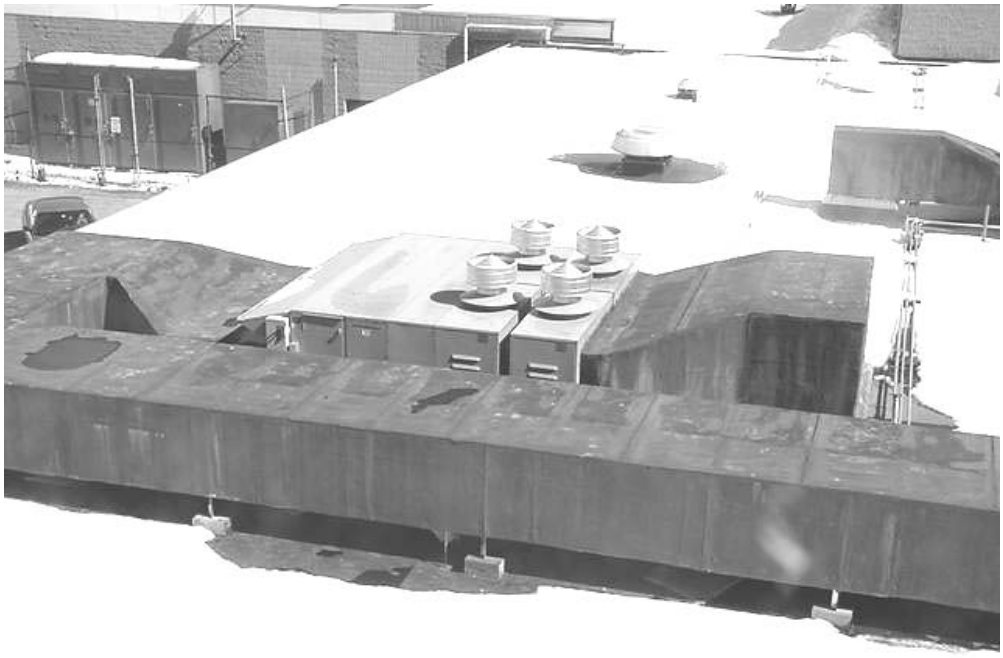


Classroom Univent Note Open Window above Unit

Picture 2

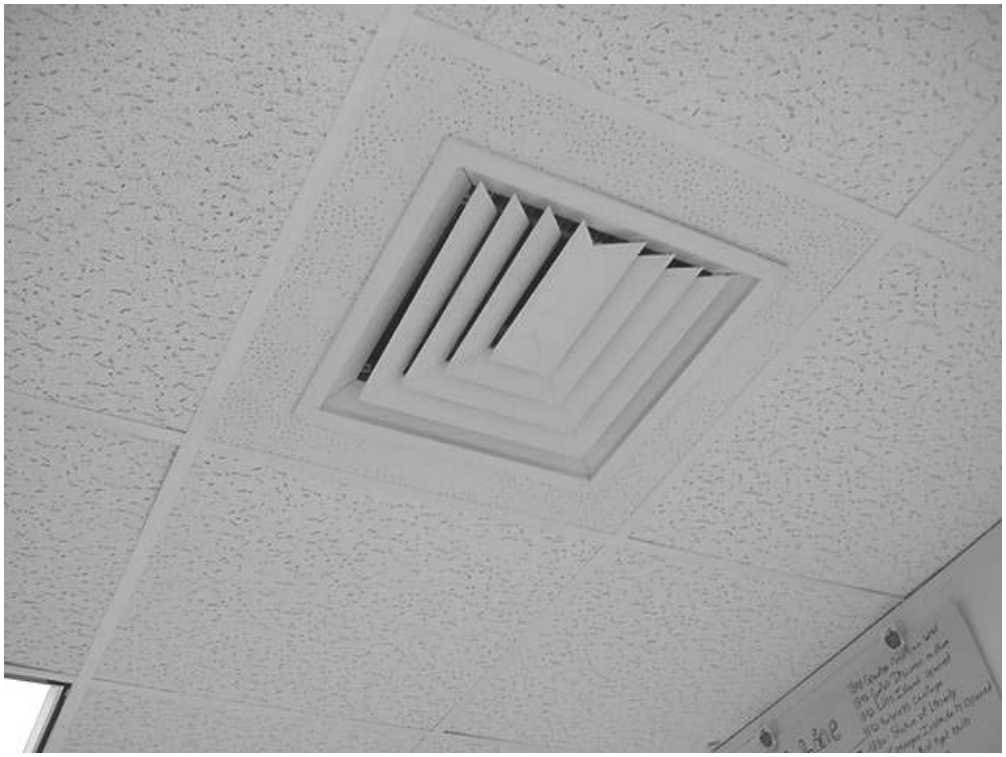
Univent Fresh Air Intakes

Picture 3



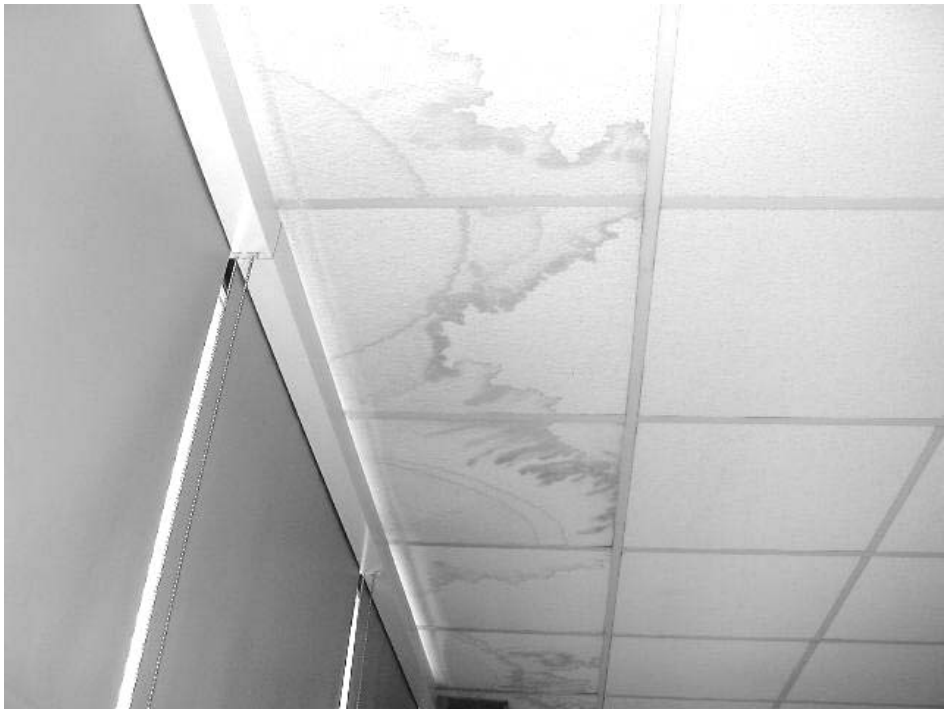
Rooftop AHU

Picture 4



Ceiling-Mounted Return Vent

Picture 5

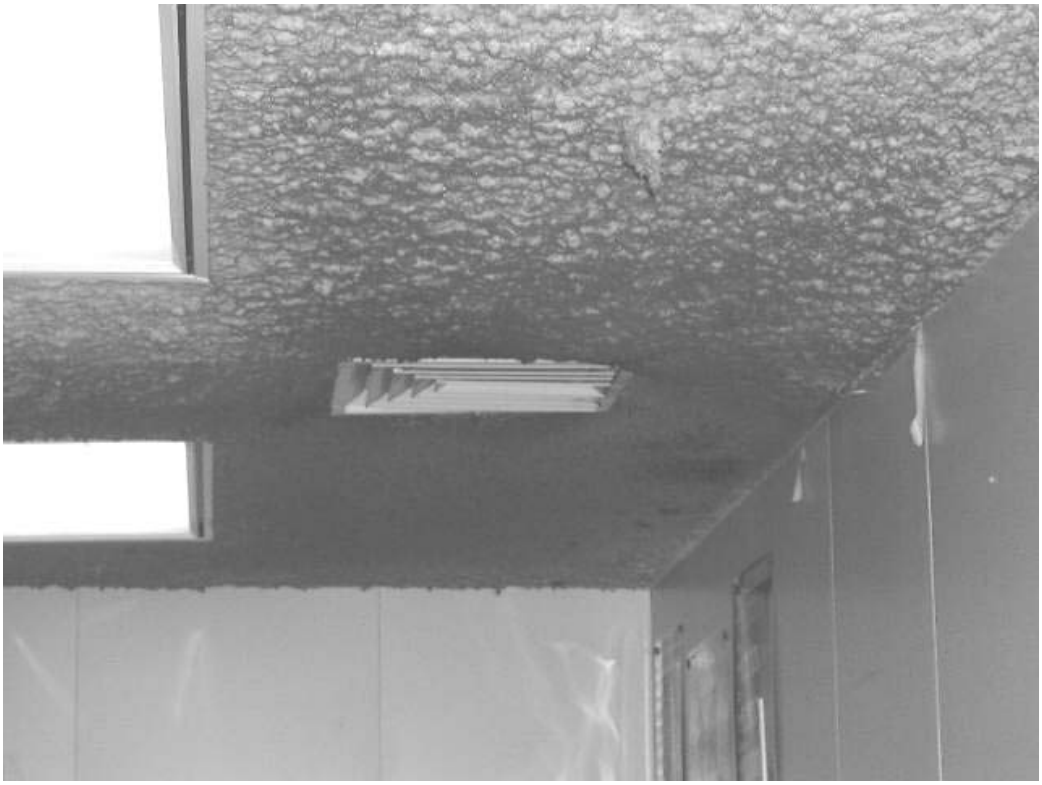


Water Damaged Ceiling Tiles

Picture 6

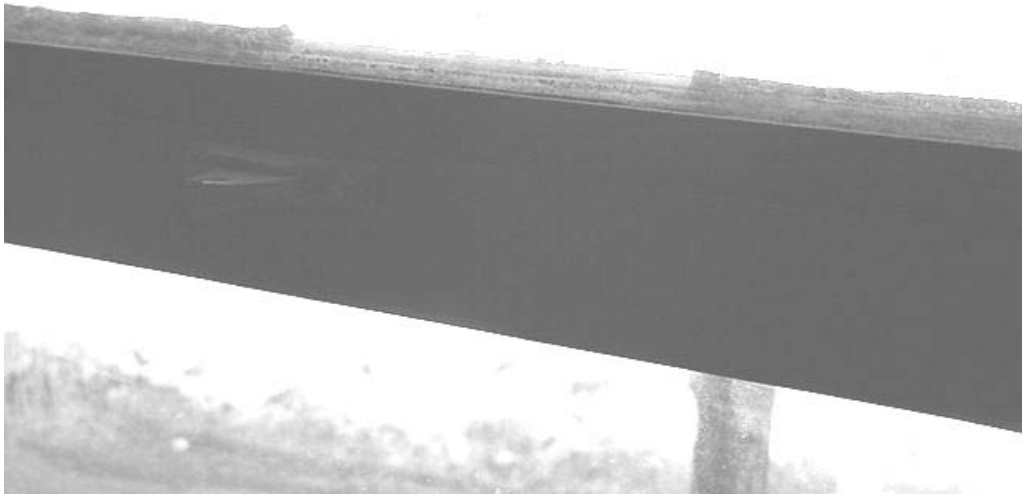
Active Water Leak in Cafeteria Note Garbage Can to Collect Rainwater

Picture 7



Spray-on Insulation Material Third Floor Ceiling Note Irregular Surface Texture and Staining around Vent

Picture 8



Missing/Damaged Window Caulking

Picture 9

Water Vapor Trapped between Window Panes

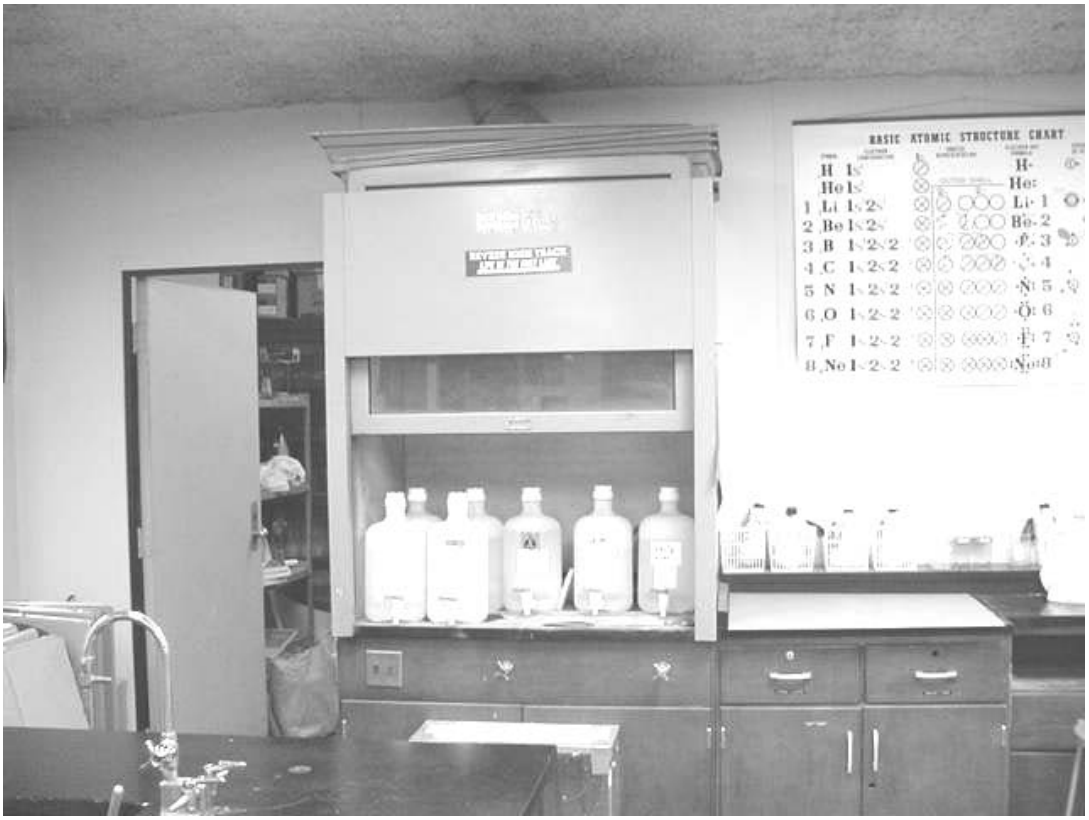
Picture 10

Broken Classroom Window

Picture 11

Chemical Storage Containers Labeled with Chemical Formula

Picture 12



Chemicals Stored in Vent Hood, Note Vent Hood Not Operating During the Assessment

Picture 13

Disconnected Local Kiln Exhaust

Picture 14

Accumulated Chalk Dust in Classroom

Picture 15

Cigarette Butts and Debris in Restroom

Picture 16

Exposed Fiberglass Insulation in Classroom 231/232

TABLE 1

Indoor Air Test Results – Revere High School, Revere, MA – March 12, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	401	48	20					Weather conditions: sunny/clear, breezy
Classroom 332	870	76	19	1	Yes			Window open, dry erase board/cleaner
Classroom 331	1101	77	20	1	Yes			Exposed fiberglass insulation, dry erase board, plants
Classroom 330	891	76	18	1	Yes	Yes		Window open, dry erase board
Classroom 321	775	73	18	8	Yes	Yes	Yes	Window open
Classroom 319	1130	74	21	14	Yes	Yes	Yes	Broken window, door open, chalk dust
Classroom 316	1013	71	20	14	Yes	Yes	Yes	Window open, chalk dust
Classroom 315	1384	72	20	10	Yes	Yes	Yes	Window open, spray cleaner, chalk
Classroom 314	1103	73	19	12	Yes	Yes	Yes	Items on univent, dry erase board, chalk dust
Classroom 313	1022	73	19	19	Yes	Yes	Yes	Chalk dust, items on univent
312 Art Room	1021	72	20	17	Yes	Yes	Yes	Plants, clay items drying on univent, sink

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results – Revere High School, Revere, MA – March 12, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Classroom 310	778	76	18	11	Yes	Yes	Yes	Window and door open
Classroom 309	860	73	18	1	Yes	Yes	Yes	Window open, univent off, 24 occupants gone <5 mins.
Classroom 308	905	73	19	1	Yes	Yes	Yes	Univent off, door open, chalk dust, dry erase board
Classroom 307	1400	73	22	10	Yes	Yes	Yes	Univent off, chalk dust, pencil shavings
Classroom 306	1126	75	20	11	Yes	Yes	Yes	Window open, dry erase board
Classroom 305	907	73	18	20	Yes	Yes	Yes	Window open, dry erase board, chalk dust
Classroom 304	951	73	19	6	Yes	Yes	Yes	Chalk dust
Classroom 302	846	73	17	1	Yes	Yes	Yes	Chalk dust, dry erase board
Classroom 301	1188	75	19	0	Yes	Yes	Yes	Dry erase board/cleaner
Classroom 232	846	74	17	0	Yes			Exposed fiberglass insulation, 10 water damaged CT, dry erase board

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TABLE 3

Indoor Air Test Results – Revere High School, Revere, MA – March 12, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Classroom 231	1450	74	19	9	Yes			Exposed fiberglass insulation, spray cleaner on desk, missing CT
Classroom 221	670	75	17	2	Yes	Yes	Yes	11 occupants gone ~15 mins., 15+ water damaged CT, chalk dust, door open
Classroom 220	1130	77	19	20	Yes	Yes	yes	Chalk dust, 3 water damaged CT along window
Classroom 219	940	75	18	19	Yes	Yes	Yes	Broken window, 5 water damaged CT near windows, door open
Classroom 218	1555	76	25	17	Yes	Yes	Yes	Univent off, 4 broken windows, 8 water damaged CT
Classroom 217	1150	75	21	21	Yes	Yes	Yes	6 water damaged CT, broken window
Classroom 216	1102	73	19	15	Yes	Yes	Yes	Water damaged CT, hole in CT, plant, floor fan, dry erase board
Classroom 215	724	71	16	0	Yes	Yes	Yes	5 water damaged CT, 2 plants, dry erase board, door open
Classroom 214	943	72	19	16	Yes	Yes	Yes	Dry erase board, 12 water damaged CT (along window), chalk dust, personal fan
Classroom 213	951	73	19	7	Yes	Yes	Yes	7 water damaged CT, 1 missing CT, floor fan, dry erase board, ~26

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	> 800 ppm = indicative of ventilation problems
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Relative Humidity -	40 - 60%

TABLE 4

Indoor Air Test Results – Revere High School, Revere, MA – March 12, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								computers
Classroom 210	945	72	18	19	Yes	Yes	Yes	13 water damaged CT (along windows), 1 missing CT, dry erase board, window open
Classroom 209	1365	75	23	7	Yes	Yes	Yes	Univent off, 14 water damaged CT, 2 plants, chalk dust
Classroom 208	1368	74	21	5	Yes	Yes	Yes	Univent off, 12 water damaged CT, 2 plants, personal fan, chalk dust
Classroom 206	1031	73	18	0	Yes	Yes	Yes	Papers over univent, 9 water damaged CT, broken CT, dry erase board
Classroom 206	720	77	17	1	Yes	Yes	Yes	Chalk dust, damaged window caulking, 6 water damaged CT
Classroom 205	959	71	19	20	Yes	Yes	Yes	Water damaged CT near windows, damaged paneling
Classroom 204	1070	70	19	15	Yes	Yes	Yes	10+ water damaged CT, condensation between window panes, chalk dust
Classroom 203	1081	72	21	20	Yes	Yes	Yes	Broken window-condensation between window panes, 4 water

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Relative Humidity -	40 - 60%

TABLE 5

Indoor Air Test Results – Revere High School, Revere, MA – March 12, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								damaged CT-near window, door open
Classroom 202	1220	71	25	17	Yes	Yes	Yes	4 water damaged CT-near window, door open
Classroom 122	1092	71	19	11	Yes	Yes	Yes	Flower on univent, broken window, water damaged ceiling, dry erase board
Classroom 120	737	70	20	10	Yes	Yes	Yes	Window and door open, univent off, window mounted a/c, 5 water damaged CT
Classroom 119	716	72	19	19	Yes	Yes	Yes	Window open
Classroom 117	1100	73	22	21	Yes	Yes	Yes	1 water damaged CT, 1 broken window
Classroom 116	1179	72	21	15	Yes	Yes	Yes	Chalk dust
Classroom 115	925	72	20	2	Yes	Yes	Yes	Chalk dust, door open
Classroom 114	1344	73	22	22	Yes	Yes	Yes	Boxes on univent, dry erase board
Classroom 113	955	72	20	24	Yes	Yes	Yes	Window and door open, items on univent, chalk dust, dry erase

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Comfort Guidelines

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TABLE 6

Indoor Air Test Results – Revere High School, Revere, MA – March 12, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								board
Classroom 109	1080	73	19	25	Yes	Yes	Yes	
Classroom 108	885	72	18	17	Yes	Yes	Yes	Window open, outside shrubbery near univent air intake
Classroom 107	1450	75	21	18	Yes	Yes	Yes	
Classroom 106	981	73	18	8	Yes	Yes	Yes	Chalk dust, missing CT
Classroom 105	736	74	16	8	Yes	Yes	Yes	Dry erase board/cleaner
Classroom 104	674	73	17	1	Yes	Yes	Yes	2 photocopiers, accumulated items, 3 plants
3rd Floor Student's Girl's Restroom							Yes	Cigarettes
2nd Floor Student's Girl's Restroom							Yes	Cigarette butts in toilets/exhaust vent, smoke odor
Classroom B-1A	600	73	17	0	No	Yes	Yes	5 water damaged CT
Classroom C-2	892	73	20	12	Yes	Yes	Yes	Dry erase board, 4 computers

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Comfort Guidelines

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Relative Humidity -	40 - 60%

TABLE 7

Indoor Air Test Results – Revere High School, Revere, MA – March 12, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Classroom B-2A	586	73	17	2	No	Yes	Yes	2 water damaged CT, door open
Classroom C-3	957	72	20	22	No	Yes	Yes	
Classroom C-5	696	68	19	1	No	Yes	Yes	Chemical exhaust hood, storage
Classroom B-5	543	73	16	1	No	Yes	Yes	~20 computers, door open
Classroom C-6	1005	71	19	17	No	Yes	Yes	Dry erase board, sinks
Classroom B-7	845	74	18	15	No	Yes	Yes	Ceiling mounted supply vents-off, 7 water damaged CT-holes, floor fan, ~20 computers
Classroom C-7	888	73	19	14	No	Yes	Yes	
Classroom C-8	1451	71	19	19	No	Yes	Yes	Dry erase board, sinks
Classroom C-9	882	71	19	12	No	Yes	Yes	Aquarium-algal growth
Classroom B-9	573	73	16	1	No	Yes	Yes	22 occupants gone ~1 hr., 10+ water damaged CT, door open

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 8

Indoor Air Test Results – Revere High School, Revere, MA – March 12, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Classroom B-10	815	72	17	13	No	Yes	Yes	10+ water damaged CT
Classroom B-11	605	72	17	10	No	Yes	Yes	Door open
Classroom B-12	750	73	17	2	No	Yes	Yes	Door open, chalk dust, temperature complaints in summer
Classroom C-13	861	72	19	14	Yes	Yes	Yes	Empty tank-odors, green algae/debris, aquariums-algae, bird cage-pigeons/wastes, door open
Classroom B-13	573	72	16	0	No	Yes	Yes	
Classroom B-15	612	74	17	2	No	Yes	Yes	Chalk dust
Outside (Background)	401	48	20					Weather conditions: sunny/clear, breezy
Teacher's Room	770	73	18	1	No	Yes (2)		UNDER RENOVATION- missing CT, fiberglass insulation, restrooms-spray cleaner on shelf, water vending machine
Special Ed. Office	1022	73	18	3	No	Yes	Yes	

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Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 9

Indoor Air Test Results – Revere High School, Revere, MA – March 12, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Special Ed. File Room	772	74	18	1	No	Yes	Yes	
Shea Office	722	72	16	1	No	Yes	Yes	2 water damaged CT-near windows, plant, personal fan
Science Office	850	73	19	3	No	Yes	Yes	4 computers, banging noise from ceiling
Principal's Office	752	69	20	7	Yes	Yes		Dry erase board/cleaner, 6+ plants, area rug
Nurse's Office	996	74	18	2	No	Yes (2)	Yes	Plant
Guidance Office – Thomas	748	73	17	0	Yes			Window open, personal fan, 1 ceiling vent-off
Guidance Office – Penney	940	74	19	0	No			1 water stained CT, 1 ceiling vent-off
Guidance Office – Nenenschwander	1050	74	21	1	No			1 ceiling vent-off, area carpet, plant, 1 water stained CT
Guidance Office – Lenihan	821	74	19	0	No			Chocolate odor, 1 ceiling vent-off, door open
Guidance Office - Goulet	874	73	19	1	No			1 ceiling vent – off
Guidance	754	73	19	15	Yes	Yes	Yes	2 window mounted a/c, 3 water damaged CT, hole in CT

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Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 10

Indoor Air Test Results – Revere High School, Revere, MA – March 12, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Green Room	733	72	18	0	No	Yes	Yes	Sink, banging noise from ceiling
Director of Fine Arts Office	732	72	17	1	No	Yes	Yes	Personal fan
Copy Room	1170	73	17	0	No	No	Yes	2 photocopiers
Cluster Office	1148	73	20	3	Yes*	Yes	Yes	Windows in inner office-1 cracked, carpet
Cafeteria Hallway								10 water damaged CT
Cafeteria								Numerous broken/stained CT, active roof leaks
Art Room Storage					No	Yes	Yes	Flammables on shelves-paint thinner, turpentine, acetone, varnish, rubber cement, material has leaked/spilt onto shelf
Chemical Storage						Yes		White debris on shelf, items identified by chemical formula vs. name, glass bottles of acids-top shelf-no bars/lip of shelf edge, acids/bases on same shelf, organics cabinet-vented-empty

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Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 11

Indoor Air Test Results – Revere High School, Revere, MA – March 12, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Assistant Principal's Office	633	73	17	1	No	Yes	Yes	4 water damaged CT, 2 photocopiers, door open
Barnes Office	600	73	17	0	Yes	Yes	Yes	11 water damaged CT, window mounted a/c, door open

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CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%